

Editorial

Rotational atherectomy in the era of drug-eluting stents

Atherosclerosis is one of the most significant underlying problems that can affect patients with cardiovascular disease. In the most serious situations, this condition affects blood supply to the heart or brain, resulting in heart attack, stroke, or sudden cardiac death. In 1977, Andreas Gruentzig performed the first percutaneous transluminal coronary angioplasty (PTCA), a less invasive method for treating obstructive coronary artery disease. However, soon after Gruentzig showed that PTCA was viable, the procedure was only undertaken when focal noncalcified lesions in the proximal coronary arteries were targeted, in an attempt to avoid serious complications such as abrupt vessel closure from intimal dissection, elastic recoil of the artery, and restenosis. In addition to these complications, the inability to dilate certain types of coronary lesions, particularly heavily calcified lesions, is another major limitation of PTCA.

Before the bare metal stent (BMS) era, the search for therapeutic strategies to overcome these PTCA limitations was based on animal studies, which showed that severe injury induced a stronger healing response of the treated vessel.¹ Angiographic analyses have revealed that the degree of late restenosis was directly proportional to the acute gain of luminal diameter achieved from angioplasty treatment, and that the proportion between late loss and acute gain was consistent for different interventional devices.² Based on these observations, the mechanical approach to plaque excision was supposed to lower the restenosis rate and improve clinical outcomes. Percutaneous coronary rotational atherectomy (PTCRA) was developed in the late 1980s as a debulking device used to facilitate the removal of plaque. Compared to arterial stretching and plaque fracture as seen in PTCA, PTCRA increases the luminal diameter by debulking atherosclerotic plaques with the aid of an abrasive diamond-coated burr.

Using routine atheroablation during percutaneous coronary intervention (PCI) is theoretically beneficial; however, clinical evidence from randomized control trials challenges this hypothesis. The rotational atherectomy and conventional balloon angioplasty (DART) comparison study, which has been widely cited for its use of PTCRA in noncomplex lesions in smaller coronary arteries (<3.0 mm), did not demonstrate a different procedural success rate or postprocedure residual stenosis rate between PTCA using adjunctive PTCRA and PTCA alone at 12 months.³ For complex coronary artery lesions, the excimer laser, rotational atherectomy, and balloon

angioplasty comparison (ERBAC) study, in which >70% of lesions were classified as American Heart Association/American College of Cardiology type B2 or C, revealed that although PTCRA had a higher initial procedural success rate (89% vs. 80%). It also showed a significantly increased target lesion restenosis (TLR) rate at 1 year (57% vs. 47%).⁴ In addition, the comparison of balloon angioplasty versus rotational atherectomy in complex coronary lesions (COBRA) study, which specifically enrolled patients with heavily calcified and complex lesions, also showed better initial procedural success with PTCRA (85% vs. 78%) but did not show any difference in restenosis rates, TLR rates, or symptomatic outcomes at 6 months.⁵

In the BMS era, the problems of coronary dissection and elastic recoil after PTCA have been solved by using coronary stenting. However, in-stent restenosis (ISR) evolved as a major issue, especially for the stenting of complex lesions such as calcified lesions, long lesions, lesions with small vessel diameters, bifurcation lesions, chronic total occlusions, and saphenous vein grafts. The reported ISR rate of BMS was 16–44%.

Is there any role of PTCRA in lowering ISR by debulking stenting, the so-called rotastenting? In the effects of debulking on restenosis (EDRES) study, compared with stenting alone, rotastenting did not improve final stent diameter, but reduced binary restenosis (BR) rates at 6 months.⁶ The debulking prior to stenting (SPORT) study, a larger trial than the EDRES trial, revealed a better procedural success rate and posttreatment minimal luminal diameter in the rotastenting group; however, no differences were observed in the rates of in-hospital major adverse cardiac event (MACE), BR, or TLR rates at the 6-month follow-up.⁷

In the absence of beneficial effects on ISR prevention, is there any role for PTCRA in ISR treatment? The atherectomy for treatment of diffuse in-stent restenosis trial (ARTIST) study randomized ISR patients to receive PTCA alone or PTCRA with adjunctive PTCA; however, no difference was observed in acute procedural success. At 6 months, the PTCRA group had an even higher restenosis rate and worse event-free survival rate.⁸ In contrast, the randomized trial of rotational atherectomy versus balloon angioplasty for diffuse in-stent restenosis (ROSTER) study showed beneficial effects in the PTCRA group, which had a lower TLR rate and lower repeat stent use at 12 months.⁹ Because the effects of PTCRA on ISR were inconsistent, the use of PTCRA is currently

limited as an adjunctive procedure in PCI to increase the success rate of subsequent angioplasty, especially in complicated calcified lesions.¹⁰

In the beginning of the third millennium, the conundrum of the high postprocedure restenosis rate has been largely eliminated by the advent of the drug-eluting stent (DES). Over the past decade, the incidence of DES failure, defined as ISR requiring target vessel revascularization (TVR), has been approximately 5–10%. Nevertheless, heavily calcified lesions remain a major technical challenge to most interventionists. First, compared with BMS, DES has a twofold higher failure rate of successful deployment in calcified lesions.¹¹ Second, Wiemer et al demonstrated that vigorous manipulation of DES through calcified lesions can damage and crack the DES polymer, which may increase the vascular inflammatory response.^{12,13} Third, suboptimal deployment of DES in these complex lesions could increase the risk of stent thrombosis.¹⁴ To overcome these problems, adequate lesion preparation and modification by PTCRA are imperative for a successful DES deployment in severely tortuous and calcified coronary lesions.

In the current issue of the *Journal of the Chinese Medical Association*, Chiang et al¹⁵ report the retrospective long-term clinical outcomes of rota-DES for heavily calcified coronary lesions in real-world practice from a single-center registry. Although similar rota-DES reports have been published in the literature, Chiang et al's report presents several unique points. This study had the oldest patients with the highest percentage of chronic renal insufficiency, diseased coronary vessels, high coronary artery calcification scores, and high bailout PTCRA rates. Nevertheless, a reasonable procedural success rate and a good long-term outcome were achieved. The study's MACE/TLR/TVR rates were also compatible with those of previously published reports. Therefore, PTCRA is again a feasible adjunctive therapy before DES implantation, especially in heavily calcified coronary lesions.

However, some unanswered questions remain concerning the use of PTCRA in the DES era. For example, does the severe extent of calcification along with crossable and expansible stenotic lesion indicate that PTCRA is necessary before DES implantation? Does the use of a different DES polymer coating affect long-term outcome?¹² What are the roles of intravascular ultrasonography for rota-DES in calcified lesion preparation and the evaluation of stent expansion adequacy? To precisely define the roles of PTCRA in the DES era, further large-scale, prospective randomized studies are required.

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